REMARKS

In response to the Office Action dated January 12, 2006, claims 1, 10, 12-14, and 28 have been amended. Therefore, claims 1-37 remain in the case. In light of the amendments and arguments set forth herein, reexamination and reconsideration of the application are requested.

Claim Objections

The Office Action objected to claims 10 and 12-14 because the term "fixed-format" should be "fixed-point format". In response, the Applicants have amended claims 10 and 12-14 to correct this error.

Section 112, First Paragraph Rejections

The Office Action rejected claims 1-37 under 35 U.S.C. § 112, first paragraph, as failing to comply with the enablement requirement. In particular, the Office Action stated that the "term 'variable length fixed-point format' is not described in the specification." Moreover, the Office Action stated that it "is not clear how it differs from fixed-point format and how it operates."

The Office Action also rejected claims 2, 3, 10-27, 29, and 30 under 35 U.S.C. § 112, first paragraph, as failing to comply with the enablement requirement. In particular, the Office Action stated that the "Applicant has not disclosed the properties of a 'normalized homogeneous coordinate system (NHCS)'".

In response, the Applicants respectfully traverse these rejections based on the following arguments. A floating-point format is a real number representation that can contain a fractional part. The decimal point is "floating" because there is no fixed number of digits before and after the decimal point. Since computers are integer machines, they can only represent real numbers using complex codes, such as the IEEE Floating-Point Standard.

A fixed-point format fixes the number of digits before and after the decimal point.

Fixed-point format represents a floating-point number in an integer format with an imaginary decimal point dividing the integer and fractional parts. Bits to the right of the imaginary decimal point represent the fractional part of the number being represented. These bits to the right use the negative powers of 2. Bits to the left of the imaginary decimal point represent the integer portion of the number being represented, and these bits use the positive powers of 2.

Moreover, three-dimensional (3D) points (such as vertices) in computer graphics can be represented using a 4-vector coordinate system, known as a homogenous coordinate system. A point in the homogeneous coordinate system is represented by four terms: (x,y,z,w). Thus, to map an arbitrary point (x,y,z,w) in the homogeneous coordinate system back to a 3D point, the first three terms are divided by the fourth term (w). In other words, the 3D point is $(x/w, y/w, z/w)$. All of the above (the floating-point format, fixed-point format, and the homogeneous coordinate system) is well known to those having ordinary skill in the computer graphics arts.

The Applicants' claimed invention includes converting rendering data in a first format (such as a floating-point format or a fixed-point format) into a variable length fixed-point format in a normalized homogeneous coordinate system. This operation is best explained by FIGS. 5 and 6 and the accompanying description of these figures in the Applicants' specification. More specifically, referring to FIG. 6, the input is a vertex having 4 scalars, *a*, *b*, *c*, and *d*. The input data can be either in a floating-point format or a fixed-point format, represented in the working example of FIG. 6 using 64 bits. "Next, the maximum size of the destination fixed-point buffer representation is determined. In FIG. 6, this size is represented by the window 600 (shown outlined as a thicker line). The maximum size of the destination fixed-point buffer is 32 bits (0-31). Thus, the size of the window is 32 bits" (specification, page 34, lines 12-15).

"Next, scaling is performed such that the maximum scalar value (scalar *c*) is scaled to the maximum size of the destination fixed-point buffer, in this case 32 bits. The shift digit *r*, or the number of digits needed to shift scalar *c*, is recorded. Finally, the

shift digit *r* is used to normalize the rest of the scalars (*a, b, d*) based on the maximum scalar *c*. This converts input data in a floating-point or fixed-point format into a NHCS fixed-point format" (specification, page 34, lines 24-28). In other words, after the maximum scalar value is found (in this case, scalar *c*), it is used to normalize the remainder of the scalars (in this case, scalars *a, b, d*). Thus, the homogenous coordinate system becomes a normalized homogeneous coordinate system (NHCS), whereby all other scalars in the vector are normalized by the maximum scalar value.

The "variable length fixed-point format" refers to the fact that the shift digit, *r*, can vary from one vector to another, depending on the maximum scalar value of the input data. This shift digit is used to normalize the data in the homogeneous coordinate system. The traditional fixed-point format lacks this property. The output of the Applicants' claimed conversion process "is the input rending data in a NHCS fixed-point format" (specification, page 4, lines 30-31).

The variable length fixed-point format in NHCS is a flexible computing data format that preserves the maximal computing resolution under a fixed length buffer (such as 32 bits). The variable length fixed-point format in NHCS gives different decimal digits in a buffer depending on the maximum scalar value of the input data. This provides higher resolution when compared to a traditional fixed-point format.

Based on the above arguments, the Applicants respectfully submit that subject application complies with the enabling requirement under 35 U.S.C. § 112, first paragraph. Accordingly, the Applicants request that rejection of claims 1-37 and claims 2, 3, 10-27, 29, and 30 under 35 U.S.C. § 112, first paragraph be withdrawn.

Section 103(a) Rejections

The Office Action rejected claims 1 and 28 under 35 U.S.C. § 103(a) as being unpatentable over Poulton et al. (U.S. Patent No. 5,388,206).

In response, the Applicants respectfully traverse these rejections based on the

claim amendments and the legal and technical analysis below. In general, the Applicants submit that Poulton et al. are missing at least one element or feature of the Applicants' claimed invention. In particular, as explained in detail below, Poulton et al. do not disclose, either explicitly or implicitly, the claimed feature of converting data into a variable length fixed-point format in a normalized homogeneous coordinate system (NHCS). Further, Poulton et al. fail to appreciate the advantages of these claimed features. Thus, the Applicants' submit that Poulton et al. cannot make obvious these claimed features of the Applicants' invention.

To make a prima facie showing of obviousness, all of the claimed features of an Applicant's invention must be considered, especially when they are missing from the prior art. If a claimed feature is not disclosed in the prior art and has advantages not appreciated by the prior art, then no prima facie showing of obviousness has been made. The Federal Circuit Court has held that it was an error not to distinguish claims over a combination of prior art references where a material limitation in the claimed system and its purpose was not taught therein. *In re Fine,* 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988). Moreover, as stated in the MPEP, if a prior art reference does not disclose, suggest or provide any motivation for at least one claimed feature of an Applicants' invention, then a prima facie case of obviousness has not been established (MPEP § 2142).

Amended Independent Claims 1 and 28

Amended independent claim 1 of the Applicants' claimed invention includes a computer-implemented method for rendering graphics on an embedded device. The method includes inputting rendering data in a first format, and converting the rendering data from the first format into a variable length fixed-point format in a normalized homogeneous coordinate system. The method also includes processing the rendering data in the variable-length fixed-point format, and rendering the processed rendering data on the embedded device.

Amended independent claim 28 of the Applicants' claimed invention includes a graphics rendering system for an embedded computing device. The system includes a task module that inputs raw rendering data in a first format and converts the raw rendering data into a second format that is a variable-length fixed-point format in a normalized homogeneous coordinate system. The system also includes an application programming interface (API) module that creates buffers for storing the converted rendering data, and a driver module that processes the converted rendering data to prepare the converted rendering data for rendering. The system further includes a rendering engine that renders the processed rendering data on the embedded computing device.

As explained above, the Applicants' claimed invention includes converting rendering data in a first format (such as a floating-point format or a fixed-point format) into a variable length fixed-point format in a normalized homogeneous coordinate system. The "variable length fixed-point format" refers to the fact that the shift digit, *r*, can vary from one vector to another, depending on the maximum scalar value of the input data. This shift digit is used to normalize the data in the homogeneous coordinate system. The output of the Applicants' claimed conversion process "is the input rending data in a NHCS fixed-point format" (specification, page 4, lines 30-31).

In contrast, Poulton et al. merely discloses a converting data from a floating point format into a traditional fixed length fixed-point format. Specifically, Poulton et al. discloses an "enhanced memory device array 125" that "converts floating-point A, B, and C coefficients into byte-serial, fixed-point form" (col. 6, lines 15-17). Nowhere do Poulton et al. disclose using the Applicants' claimed feature of converting data into a variable length fixed-point format in a normalized homogeneous coordinate system (NHCS). Consequently, no motivation or suggestion for the claimed features of the Applicants' invention is provided. Absent this teaching, motivation or suggestion, Poulton et al. cannot render the Applicants' claimed invention obvious (MPEP § 2143.01).

Poulton et al. also fails to appreciate or recognize the advantages of the Applicants' claimed feature of converting data into a variable length fixed-point format in a normalized homogeneous coordinate system (NHCS). More specifically, the advantages of converting input rendering data in a floating-point format or a traditional fixed-point format to a variable length fixed-point format in a NHCS is that "NHCS is a high-resolution variation of fixed-point number representation" (specification, page 22, lines 8-10). In addition, "NHCS can eliminate the annoying overflow, and provides a wider data space. For example, without NHCS, the model space vertex coordinates range from 2^{-16}~2^{15}, assuming that a 16-bit mantissa is used. On the other hand, if NHCS is used, the model space vertex coordinates range from 2^{-31}~2^{31}. By adopting NHCS it can be seen that both range and precision are greatly increased" (specification, page 23, lines 16-21).

"NHCS also makes the conversion from floating-point to fixed-point easy. It is not necessary to know the exact range of the input vertices. NHCS also eliminates the factitious overflow and takes advantage of the full storage of the buffer. Moreover, NHCS has the advantage of providing a wider data representation given the same precision. NHCS also preserves all transform and lighting (T&L) operations and makes use of the "w" in homogeneous coordinate representation" (specification, page 23, lines 22-28). Poulton et al. fail to discuss or appreciate these advantages of the Applicants' claimed features.

The Applicants, therefore, submit that obviousness cannot be established since Poulton et al. fail to teach, disclose, suggest or provide any motivation for the Applicants' claimed feature of converting data into a variable length fixed-point format in a normalized homogeneous coordinate system (NHCS). In addition to explicitly lacking these features, Poulton et al. also fail to implicitly disclose, suggest, or provide motivation for these features. Further, Poulton et al. fail to appreciate advantages of these claimed features.

Therefore, as set forth in *In re Fine* and MPEP § 2142, Poulton et al. do not render the Applicants' claimed invention obvious because the reference is missing at

least one material feature of the Applicants' claimed invention. Consequently, because a prima facie case of obviousness cannot be established due to the lack of "some teaching, suggestion, or incentive supporting the combination", the rejection must be withdrawn. ACS Hospital Systems, Inc. v. Montefiore Hospital, 732 F.2d 1572, 1577, 221 USPQ 929, 933 (Fed. Cir. 1984); MPEP 2143.01.

Accordingly, the Applicants respectfully submit that amended independent claims 1 and 28 are patentable under 35 U.S.C. § 103(a) over Poulton et al. based on the amendments to claims 1 and 28 and the legal and technical arguments set forth above and below. The Applicants, therefore, respectfully request reexamination, reconsideration and withdrawal of the rejection of claims 1 and 28 as being unpatentable over Poulton et al.

Conclusion

In view of the amendments to claims 1 and 28 and the arguments set forth above, the Applicants submit that claims 1-37 of the subject application are in condition for immediate allowance. The Examiner, therefore, is respectfully requested to withdraw the outstanding rejections and objections of the claims and to pass this application to issue.

In an effort to expedite and further the prosecution of the subject application, the Applicants kindly invite the Examiner to telephone the Applicants' attorney at (805) 278-8855 if the Examiner has any comments, questions or concerns, wishes to discuss any aspect of the prosecution of this application, or desires any degree of clarification of this response.

Respectfully submitted,
Dated: April 12, 2006

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